Health Service Support from the Sea Base

By DAVID A. LANE

Hospital ship USNS *Mercy* en route to Papua New Guinea to provide medical care for tsunami victims

U.S. Navy (Dennis C. Cantrell)

Sea basing has been called a "critical future joint military capability for the United States" because it offers a mobile, reliable, and secure environment from which to operate when suitable fixed bases are not available, providing the joint task force commander with unprecedented offensive power and operational independence.[1] The main conceptual difference between sea basing and current amphibious doctrine is that the former exploits the advantages of rapid movement directly from the sea base to the objective (for example, ship-to-objective-maneuvers, or STOM) without the need for a buildup of combat power, materiel, and reinforcements on a shore beachhead, with the sea base itself providing support and sustainment until ports and airheads have been secured and adequately defended.[2] The lack of a logistic beachhead and the small logistic footprint inherent with sea basing and STOM present major challenges to providing health services support (HSS), particularly combat care. This article argues that these challenges could preclude military medicine from providing combatant commanders and subordinate joint task force commanders with adequate casualty care in the field and at the sea base during expeditionary operations with high casualty rates.

Health Services Support Primer

Joint doctrine provides that battlefield casualties flow through five phases of treatment: first responder, forward resuscitative surgery, theater hospitalization, en route care, and care outside the theater. The HSS infrastructure is therefore structured with five echelons of care which Joint Publication 4–02, *Doctrine for Health Service Support in Joint Operations*, lists as:

1. self-aid, buddy aid, and emergency lifesaving skills
2. physician-directed resuscitation, stabilization, emergency procedures, and forward resuscitative surgery
3. advanced resuscitative care requiring hospitalization, including surgery, postoperative management, and initial restorative procedures
4. rehabilitative and recovery therapies
5. definitive care, including the full range of acute, convalescent, restorative, and rehabilitative services.

From an operational commander's perspective, tactical mobility decreases substantially as HSS capability increases from level 1 to level 5. Level 1 care, for

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example, is provided at mobile battalion aid stations ashore and in sick bays aboard most ships, while level 2 care is provided at transportable (not mobile) medical/surgical companies ashore and aboard designated large-deck casualty receiving and treatment ships (CRTSs). Massive fleet and field hospitals, deep draft T–AH class hospital ships, and fixed base medical treatment facilities (MTFs) in the communications zone have level 3 capabilities. By doctrine and practice, level 4 and 5 capabilities are normally available only at military and civilian medical centers in the continental United States (CONUS).

In contrast to decreased mobility, the patient-holding capacity and logistic footprint of HSS increase as casualties advance through the levels of care. A battalion aid station is an integral part of the unit it supports and is staffed with one or two medical officers and a team of hospital corpsmen or medics. It can be set up in moments and is immediately capable of providing emergency care. But because it has no holding capacity, patients must be returned to duty or evacuated to a higher echelon of care. A surgical company, on the other hand, takes about a day to set up, can perform initial resuscitative surgeries and administer blood products, and has a holding capacity of 50 to 60 patients.[3] At the other end of the spectrum is the deployable fleet or field hospital. It takes a week or more to construct the 250-bed variant, which is larger than a football field and has more than 550 medical and support personnel. It can provide major surgeries, postoperative care, and intensive/critical care for relatively large numbers of casualties.[4]

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Although advances in HSS have generally kept pace with advances in medicine, the current continuum that moves a patient from the point of wounding to a final medical disposition has its roots in the clinical practices and evacuation methods of World War II. Moreover, a casualty's length of stay at a given level is determined more by the combatant commander's theater evacuation policies and the availability of evacuation resources than by clinical factors or bed capacity.

During Operation *Iraqi Freedom*, for example, the theater evacuation policy was 1 week, even though there was ample bed capacity in the combat and communications zones to care for patients longer. Casualties were light, and the system had considerable excess capacity. Over 90 percent of patients evacuated to MTFs in the communications zone were further evacuated to CONUS on the next available evacuation flight, with no apparent direction from the combatant commander to return any of the wounded to combat duty.

A Smaller Logistic Footprint

Sea-based operations and operational maneuver from the sea will require a smaller, more mobile logistic footprint ashore. In turn, expeditionary medical assets will have to be smaller, more agile, and "able to operate from austere sites at sea or on shore and to smoothly transition between the two."[5]

In response to these requirements, planners envision that medical personnel will provide only *essential care* in theater, using specially trained nonphysician medical personnel (for example, hospital corpsmen and medics) at the site of injury or wounding, followed by forward resuscitative surgery as close as practical to the battlefield, followed by rapid evacuation out of the theater for more definitive care.

Additional HSS footprint reductions could be achieved by placing an Army rotary wing air ambulance detachment under the tactical control of each future medical battalion to provide dedicated aeromedical evacuation support because, in a sense, a large number of beds ashore during sea-based operations reflects inadequate patient movement capacity.

Evolving joint medical doctrine specifies that *essential care* will be restricted to "resuscitative care and en route care as well as care to either return the patient to duty (within the theater evacuation policy) or begin initial treatment required for optimization of outcome and/or stabilization to ensure the patient can tolerate evacuation to the next level of care."[6] In effect, this doctrine will trade the excess capacity of the current system for rapid stabilization and increased reliance on aeromedical evacuation. One unintended consequence will be "stabilized—*but not necessarily stable*—patients being evacuated" outside the theater for definitive treatment.[7]

This change in HSS doctrine will require casualty care innovations—including some that are, at best, under development. The innovations will need to be implemented along the entire casualty care continuum, from the point of wounding to MTFs in the United States. The remainder of this article critically examines three innovations that will serve as vital operational nodes in the delivery of HSS: forward resuscitative surgery, evacuation of casualties to and from the sea base, and in-theater care.

Forward Resuscitative Surgery

For reporting purposes, Joint Publication 4–02 categorizes casualties according to type and status. The major headings include: killed in action (KIA), died of wound(s) received in action (DOW), wounded in action (WIA), and disease and nonbattle injury (DNBI). Casualties are considered KIA if they are "killed outright" or die "as a result of wounds . . . before reaching a medical treatment facility." Since 90 percent of battlefield deaths are classified as KIA, most due to uncontrolled hemorrhage, minimizing the time to treatment is critical. A delay of minutes in receiving care can mean the difference between life and death.

First responders and level 1 aid stations cannot provide adequate care for most wounded patients with active

bleeding. These patients need immediate surgery. This statement is more controversial than it appears. At least one published report reviewed survival data from more than 10,000 casualties from recent wars and concluded that many patients "even with severe injuries do not necessarily require surgery" for many days or even weeks to survive.[8]

Until recently, Marine Corps surgical companies, elements of a medical battalion staffed by Navy medical personnel, were the only source of organic expeditionary medical support for Marine forces above the battalion aid station level and the most forward-deployed source of level 2 surgical capabilities. Because they have limited holding capacity and are vital links in the medical evacuation chain, Marine Corps doctrine states that these companies should be located close to an airfield that can evacuate casualties using fixed-wing aircraft. While this doctrinal policy may be necessary to prevent saturation of a unit's bed capacity and ensure adequate force protection, it is counter to both optimal medical management, as noted above, and the emerging doctrine of health service support for sea basing and STOM.

Patient is carried to UH–60 for treatment in Baghdad, Operation *Iraqi Freedom*

U.S. Marine Corps (Tasha M. Fontaine)

Naval Medicine's Forward Resuscitative Surgery System (FRSS) and similar Army units called Forward Surgical Teams (FSTs) have been deployed to take *essential* level 2 surgical care as close to the forward edge of the battle area (FEBA) as possible. The greatest challenge, however, is keeping it close despite the rapid tactical advances of expeditionary maneuver warfare elements. Six FRSS teams provided trauma care for the Marines during the major combat operations phase of *Iraqi Freedom*, and the Army deployed about three FSTs per combat division. Outcome data from clinical experience is statistically inconclusive compared with earlier conflicts, including Mogadishu in October 1993, and older, more robust data from Vietnam. In both Somalia and in Iraq, for example, the KIA rate was 18 percent, suggesting that the proximity of forward surgery systems or teams to the FEBA (often within 5 kilometers) and rapid evacuation from the point of wounding to the FRSS (typically 30 minutes) were not enough to prevent the death of many severely wounded casualties.[9] Nonetheless, the mere presence of the FRSS or FST near the front lines probably boosts warfighter morale, an effect that should not be overlooked, even if the clinical impact is marginal and the casualty numbers are too small to be extrapolated to future conflicts.

The FRSS and FSTs are not a health services panacea, however, even if the concept eventually proves to be medically efficacious. If these small mobile teams totally replace surgical companies as the most forward level 2 surgical asset, they will need robust support from dedicated air and ground ambulances because they lack a significant patient holding capacity of their own. Unlike the Army, the Marines have opted not to use dedicated air ambulances, relying instead on airlifts of opportunity. The existing methods have been sufficient arguably because deployed surgical companies and fleet and field hospitals have had excess bed capacity that could accommodate substantial delays in patient evacuation. In the absence of dedicated air ambulances, the joint force air component commander or Marine aviation combat element commander will need to decide whether to divert scarce aviation resources for medical evacuation or have a substantial number of the "stabilized—*but not necessarily stable*—patients" die awaiting evacuation. On the other hand, the logistic footprint could actually get bigger than today's HSS package if the FRSS and

sister programs are fully implemented and the organic level 2 holding capacity is retained in its present form.

En Route Care

Expeditionary forces employing ship-to-objective tactics can operate hundreds of miles from the sea base, making en route care back to the base an area of concern. Much has already been learned from Operation *Enduring Freedom*, which approximated the HSS and logistic considerations of sea basing. In his post-operation testimony to the Senate Armed Services Committee, the Central Command Surgeon cited the life-saving value of enhanced en route critical care capabilities and predicted it would serve as a template for future operations.[10]

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In this regard, for Operations *Enduring Freedom* and *Iraqi Freedom* and for future sea-based operations, the Marines have assembled a "modular system that includes medical equipment, medical treatment protocols, and consumable supplies necessary for the medical management of two critically injured/ill, but stabilized, casualties during transport onboard [aircraft] from elements ashore" to the sea base.[11] The concept of operations for this tactical en route care system is to place it in the aviation combat element for staging at forward operating bases (and/or the sea base):

> *when needed, aircrew and a team of medical personnel (flight surgeon, flight nurse, and hospital corpsman) will install the en route care system (ERCS) in an available aircraft within 10 minutes and transit to the site of the casualty needing urgent transport. The ERCS and medical personnel are then expected to provide care for two stabilized casualties for up to a 2-hour transit to the appropriate receiving MTF, most likely aboard the sea base.*[12]

Despite the system's name, the ERCS medical team will not be trained or equipped to provide *en route care* and, in fact, will only perform "clinical interventions per pre-approved protocols . . . necessary to prevent clinical degradation while in transit."[13] In contrast, the Air Force can deploy a de facto airborne intensive care unit and Critical Care Air Transport Teams (CCATTs) for long-haul, intertheater/strategic aeromedical evacuations.

Full operational capability of the ERCS is 60 sets, including specialized training for 48 ERCS medical teams. A similar prototype system was employed during Operation *Iraqi Freedom* to evacuate 34 casualties (28 Iraqis and 6 Marines) from forward FRSS units.[14] Two severely wounded patients, in particular, partially validated the ERCS concept. They were intubated, mechanically ventilated, medically paralyzed, and chemically sedated during the 350-mile transport from Baghdad to Kuwait City using a combination of rotary- and fixed-wing aircraft and ground ambulances.

While the anecdotes from *Iraqi Freedom* represent real success stories, two critical patients and otherwise light casualties from a month of combat provide insufficient data to determine whether the ERCS concept can support sustained expeditionary sea-based operations. How stable a "stabilized" patient really is has not been adequately tested. Nor has the need arisen to deny or substantially delay aeromedical evacuation due to a lack of airlifts of opportunity. The post–*Iraqi Freedom* report on FRSS unit activities recorded that the mean delay for an airlift from a FRSS was 8 hours. Survival rates could suffer if casualty rates were higher or airlift delays longer.

Sea-Based Hospital Care

After battlefield casualties have been stabilized for transport and a system put in place to transport them, their survival will depend on having a ready, capable receiving platform, traditionally a deployed fleet or field hospital (or hospital ship) with level 3 capabilities, followed by onward evacuation to level 4 and 5 MTFs in the continental United States. To support

347th Communications Squadron (Rob Jensen)

National Guardsman at contingency aeromedical staging facility for evacuation to Landstuhl, Germany, for follow-on treatment

Army surgeons in Kandahar, Afghanistan, Operation *Enduring Freedom*

55th Signal Company, Combat Camera (Johnny R. Aragon)

sea-based operations, however, emphasis will shift from hospitals ashore to an organic sea-based level 3 capability on the sea base itself, which will, perhaps, present the biggest operational challenge with regard to sea-based combat health services support.

The key logistic piece of sea basing is the Future Maritime Prepositioning Force [MPF(F)] with its subordinate Maritime Prepositioning Squadron (MPSRON), which will support, sustain, reconstitute, and redeploy the sea base and the joint force from an advanced logistic base hypothetically located 2,000 nautical miles away. The Future MPSRON—composed of six to eight deep-draft, high-capacity ships of a new class—will be forward deployed to a theater and specifically preloaded to support the full spectrum of sea-based operations. Some scenarios call for multiple MPSRONs. Each squadron will include two ships equipped and staffed to serve as level 3 casualty receiving and treatment ships (CRTS).[15]

The medical treatment facility in each CRTS is projected to have six operating rooms and 121 hospital beds, including 38 intensive care unit beds and 83 hospital ward beds. In addition to level 3 hospital care, the ships will also provide laboratory, pharmacy, radiology, blood banking, telemedicine, medical logistic, and mortuary services in support of expeditionary land forces. Moreover, the deployed expeditionary strike group will retain level 2 capabilities in its assault ships. In a worst-case scenario, however, in which logistic footprint constraints preclude a substantial HSS presence ashore, these sea-based hospital beds in the MPSRON and the strike group could be the only inpatient casualty holding capacity available to the combatant commander for up to 2,000 nautical miles.

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Three hundred beds afloat may sound adequate given the low numbers of casualties in recent operations, but continued low casualties cannot be assumed. It is more alarming that an acceptable platform, proposal, or concept does not yet exist to evacuate patients from the sea base to the advanced logistic base. The shore-based system was stressed during Operation *Iraqi Freedom*, even with the low numbers of casualties. Recent wargaming suggests that clearing the sea base of casualties will require a long-range, medium or heavy lift, sea-based aircraft, and lack thereof has been identified as a critical obstacle to sea base success by the Defense Science Board, along with inadequate at-sea cargo handling (patient handling) capabilities under realistic sea conditions.[16] The difficulties with maintaining throughput may become insurmountable when caring for chemical, biological, or nuclear casualties, or when, as in recent wars, large numbers of noncombatant and enemy casualties are treated in U.S. MTFs.

Counterpoints

The three health service support nodes discussed here—forward resuscitative surgery, en route care, and sea-based level 3 care—have the potential to enhance the health services support military medicine provides combatant commanders by substantially improving combat casualty care.

Although the FRSS teams of Operation *Iraqi Freedom* did not provide dramatically greater clinical outcomes, their concept of operations has validity—putting advanced life-saving care as close to the point of wounding as possible. In *Iraqi Freedom,* the FRSS and FSTs with their governing doctrine and tactical employment were new to U.S. commanders. Consequently, their clinical impact may not have been as significant as envisioned. Clinical outcomes may improve, however, as warfighters, logisticians, and health care providers gain experience with the concept and apply lessons learned. In addition, the statistical power of analysis will increase as the number of casualties treated by FRSS units grow and their impact on KIA and DOW rates becomes more fully understood at the clinical, tactical, and operational levels.

While the military health system has demonstrated the ability to put advanced medical capabilities virtually anywhere needed and in the harshest environments, providing adequate en

route care remains difficult at best. But forward medical units cannot function in a vacuum, and severely injured or ill patients must eventually be moved to MTFs with adequate and/or specialized resources. The Marine Corps ERCS and Air Force CCATTs appear to be steps toward state-of-the-art care during en route phases of casualty management. Issues need to be addressed, however, especially the limited availability of ERCS equipment and shortage of dedicated aeromedical evacuation platforms and personnel in order for these innovations to become the ultimate solution.

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However, the fact that the ERCS concept is being driven by line warfighters who recognize it as a vital unmet need for conducting extended-range STOM bodes well for this program.

As mentioned, sea-based operations have been labeled a critical future military capability. Unfortunately, maintaining bidirectional throughput at the sea base to simultaneously clear it of casualties while sustaining the combat force ashore is perhaps the biggest challenge to the sea-basing model, in general, and to sea-based HSS. This obstacle is common to all potential users of future sea bases, allowing military medicine to benefit from the concerted effort of the entire Department of Defense toward solving this future logistic quagmire. Several platforms are already being studied to help clear the sea base MTF, for example, including evacuation connector ships and high-speed vessels. Moreover, much attention is being directed toward a heavy lift, sea-based aircraft because the success of all sea-based logistic sustainment innovation relies on its development.

Military medicine is working on innovative strategies to meet the mission of providing health service support and casualty care to joint forces operating from a sea base. FRSS units, ERCS equipment sets and personnel, and level 3 hospital care aboard MPSRON ships are examples of these strategies. To best exploit the opportunities they offer while mitigating their risks, Navy Medicine and its equivalent medical departments in the Army and Air Force will need to maintain level 2 surgical capability and a holding capacity ashore. In other words, some version of today's medical/surgical battalion must be adapted for future use to provide inpatient casualty care and holding even in the era of sea-based operations, because U.S. inability to assure rapid evacuation when and where needed is the Achilles heel of all three innovations on the horizon. The medical battalion of the future and its service equivalents will need to be smaller, lighter, and more modularized to better support maneuver forces, but this should be readily achievable using available, advanced commercial technologies and transformed evaluation and procurement processes.

Dedicated medical airlift support—when combined with the appropriate reengineering of the medical battalion to judiciously reduce its capacity, weight, and footprint—will enhance casualty care for future warriors wounded on the battlefield and have synergistic effects with the innovations described here. The key will be to maintain a buffer—or capacity safety valve—until newer technologies come on line, such as a heavy lift vehicle for moving the wounded from the hospital at sea to a more capable facility. These adaptations to present plans for sea-based operations will ensure that military medicine remains the expeditionary maneuver element's medical force in readiness. **JFQ**

NOTES

[1] Defense Science Board, *Final Report of the Defense Science Board Task Force on Sea Basing* (Washington, DC: Defense Science Board, August 2003), vii–viii; Vern Clark, "Sea Power 21 Series—Part I: Projecting Decisive Joint Capabilities," *U.S. Naval Institute Proceedings* (October 2002).

[2] Defense Science Board, 16–22.

[3] Blood products are specifically mentioned as a metric of logistic complexity. They must be kept continuously refrigerated, in which case they have a limited shelf life, or frozen, so they require special handling during reconstitution and thawing. Blood products are a critical component of level 2 HSS and are rapidly consumed when caring for battlefield casualties.

[4] Depending on their configuration, fleet hospitals have the capacity to hold 116, 250, or 500 patients. The 116-bed version is more correctly called an expeditionary medical facility.

[5] Navy Warfare Development Command and Marine Corps Combat Development Command, "Concept of Naval Force Health Protection for the 21st Century" (Newport, RI: draft dated November 6, 2003), 2.

[6] Joint Chiefs of Staff, "Force Health Protection in the 21st Century Capstone" (Washington, DC: draft July 3, 2003), 42.

[7] Ibid., 28–32. Emphasis added.

[8] R.M. Coupland, "Epidemiologic Approach to Surgical Management of the Casualties of War," *British Medical Journal* (June 25, 1994), 1,693–1,697.

[9] In Vietnam, 75–80 percent of KIAs died within 5 minutes of wounding. To make a significant intervention within this narrow timeframe would require that first responders be able to immediately intervene with high volume fluid and blood product replacement or with surgery.

[10] Ronald A. Maul, "Statement of Command Surgeon, U.S. Central Command," Senate Armed Services Committee Subcommittee on Personnel, *Hearings on Medical Support of Forces Participating in Operation* Enduring Freedom, 107th Cong., 2d sess., March 13, 2002, 2.

[11] K.J. Glueck, Jr., to Chief of Naval Operations (N931D), "Training for the En Route Care System," Marine Corps Combat Development Command letter 1500/C39, October 8, 2002, Quantico, VA.

[12] Marine Corps Combat Development Command, "Draft Operational Requirements Document for the En Route Care System," March 17, 2003, Quantico, VA.

[13] Ibid.

[14] Corley E. Puckett, "USMC En Route Care System," brief preceding *En Route Care* Wargame, Navy Warfare Development Command, Newport, RI, March 9, 2004.

[15] Navy Warfare Development Command and Marine Corps Combat Development Command, "Draft MPF(F) Concept of Operations," Newport, RI, March 8, 2004.

[16] Defense Science Board, 91–94.